**Excavation Plan and Sequential Process Narrative**

INEEL/EXT-02-00703
Revision 0

# Excavation Plan and Sequential Process Narrative for the OU 7-10 Glovebox Excavator Method Project

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*October 2002*

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Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

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# ABSTRACT

This document describes the excavation plan and sequential process steps for the Operable Unit 7-10 Glovebox Excavator Method Project's operations activities. Waste zones (i.e., areas containing specific waste types, such as graphite, sludges, or combustibles) within the excavation site are mapped and discussed, including comparisons with probing data. The order or sequence of excavation for overburden and waste layer materials is described, along with rationale for the recommended excavation sequence. Justification for leaving or relocating probes in the excavation site is also provided. Finally, a narrative of the operational process steps is given, which walks sequentially through the various operational activities of the project (e.g., overburden removal, waste retrieval, and waste packaging).

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# ACRONYMS

| | |
|---|---|
| ARA | airborne radiation area |
| CCTV | closed-circuit television |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CSS | core soil sample |
| D&D&D | deactivation, decontamination, and decommissioning |
| DEAR | U.S. Department of Energy Acquisition Regulation |
| DLE | drum loadout enclosure |
| DOE | U.S. Department of Energy |
| DOE-ID | U.S. Department of Energy Idaho Operations Office |
| DST | drum sizing tray |
| EDF | Engineering Design File |
| FMM | fissile material monitor |
| HEPA | high-efficiency particulate air |
| HVAC | heating, ventilation, and air conditioning |
| INEEL | Idaho National Engineering and Environmental Laboratory |
| INTEC | Idaho Nuclear Technology and Engineering Center |
| MCP | management control procedure |
| OU | operable unit |
| PDSA | Preliminary Documented Safety Analysis |
| PGS | Packaging Glovebox System |
| PPE | personal protective equipment |
| RAD | radiological |
| RadCon | radiological control |
| RCS | Retrieval Confinement Structure |

| | |
|---|---|
| RCT | radiological control technician |
| RSIM | radiological system input module |
| RWMC | Radioactive Waste Management Complex |
| SDA | Subsurface Disposal Area |
| TFR | Technical and Functional Requirement |
| VOC | volatile organic compound |
| WAC | waste acceptance criteria |
| WES | Weather Enclosure Structure |

# Excavation Plan and Sequential Process Narrative for the OU 7-10 Glovebox Excavator Method Project

## 1. INTRODUCTION

This report documents the excavation plan and the sequential process steps needed to excavate waste, remove obstructive probes, and sample underburden for the Glovebox Excavator Method Project waste retrieval demonstration. The project is located at the Idaho National Engineering and Environmental Laboratory (INEEL). The *Record of Decision: Declaration of Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory, Idaho Falls, Idaho* (DOE-ID 1993) specifies environmental remediation of transuranic waste from Operable Unit (OU) 7-10, known as Pit 9. On October 1, 2001, the INEEL published the *Waste Area Group 7 Analysis of OU 7-10 Stage II Modifications* (INEEL 2001), which identifies a feasible approach for retrieving waste from OU 7-10. The OU 7-10 Glovebox Excavator Method Project was established to accomplish the objectives presented in that report. The overall objectives for the project are as follows:

- Demonstrate waste zone material retrieval from OU 7-10
- Provide information on any contaminants of concern present in the underburden
- Characterize waste zone material for safe and compliant storage
- Package and store waste onsite, pending the decision on final disposition.

Retrieval Operations will be complete when all of the following activities have been completed. These activities do not necessarily run sequentially and, in fact, may overlap.

1. A minimum 75 $yd^3$ of waste zone material has been excavated within the retrieval area
2. The retrieved waste zone material has been assayed, determined to be less than 200 FGE per drum, and sent to temporary storage (onsite)
3. The retrieved waste zone material has been sampled
4. The exposed underburden below the retrieval area has been sampled
5. Security has reviewed the last of the glovebox record of handling videotapes and all suspect security items have been dispositioned
6. The U.S. Department of Energy (DOE) has provided a Notification of Completion of Stage II Excavation to the Agencies, and the agencies agree that excavation is complete.
7. All waste items and outliers have been evaluated to identify the need for returning the material to the pit or processing in the glovebox, and no further need to perform these activities exists.

## 1.1 Project Background

The INEEL is a DOE facility—located 52 km (32 mi) west of Idaho Falls, Idaho—that occupies 2,305 $km^2$ (890 $mi^2$) of the northeastern portion of the Eastern Idaho Snake River Plain. The Radioactive Waste Management Complex (RWMC) is located in the southwestern portion of the INEEL, as shown in Figure 1. The Subsurface Disposal Area (SDA) is a 39-ha (97-acre) area located within the RWMC. Waste Area Group 7 is the designation recognized by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq.) and in the *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory* (DOE-ID 1991) for the RWMC, which comprises the SDA buried waste site. Waste Area Group 7 has been subdivided into 13[a] OUs. Pit 9, designated OU 7-10, is located in the northeast corner of the SDA. The OU 7-10 site is an area into which chemicals, radioactive materials, and sludge from DOE weapons plants and other government programs were disposed of. While such disposal at the RWMC began in 1952, OU 7-10 was used and filled in the late 1960s. The Glovebox Excavator Method Project involves a designated portion of OU 7-10, as illustrated in Figure 2.

The project is located in the southwest end of OU 7-10. A fan-shaped area with a 6-m (20-ft) radius and the angular extent of 145 degrees defines the project area. Figure 3 presents the plot plan of the OU 7-10 area showing infrastructure and the project location. Operable Unit 7-10 itself measures approximately 115.5 × 38.7 m (379 × 127 ft).

a. Operable Units 13 and 14 were combined into the comprehensive remedial investigation/feasibility study in 1995 (Huntley and Burns 1995).

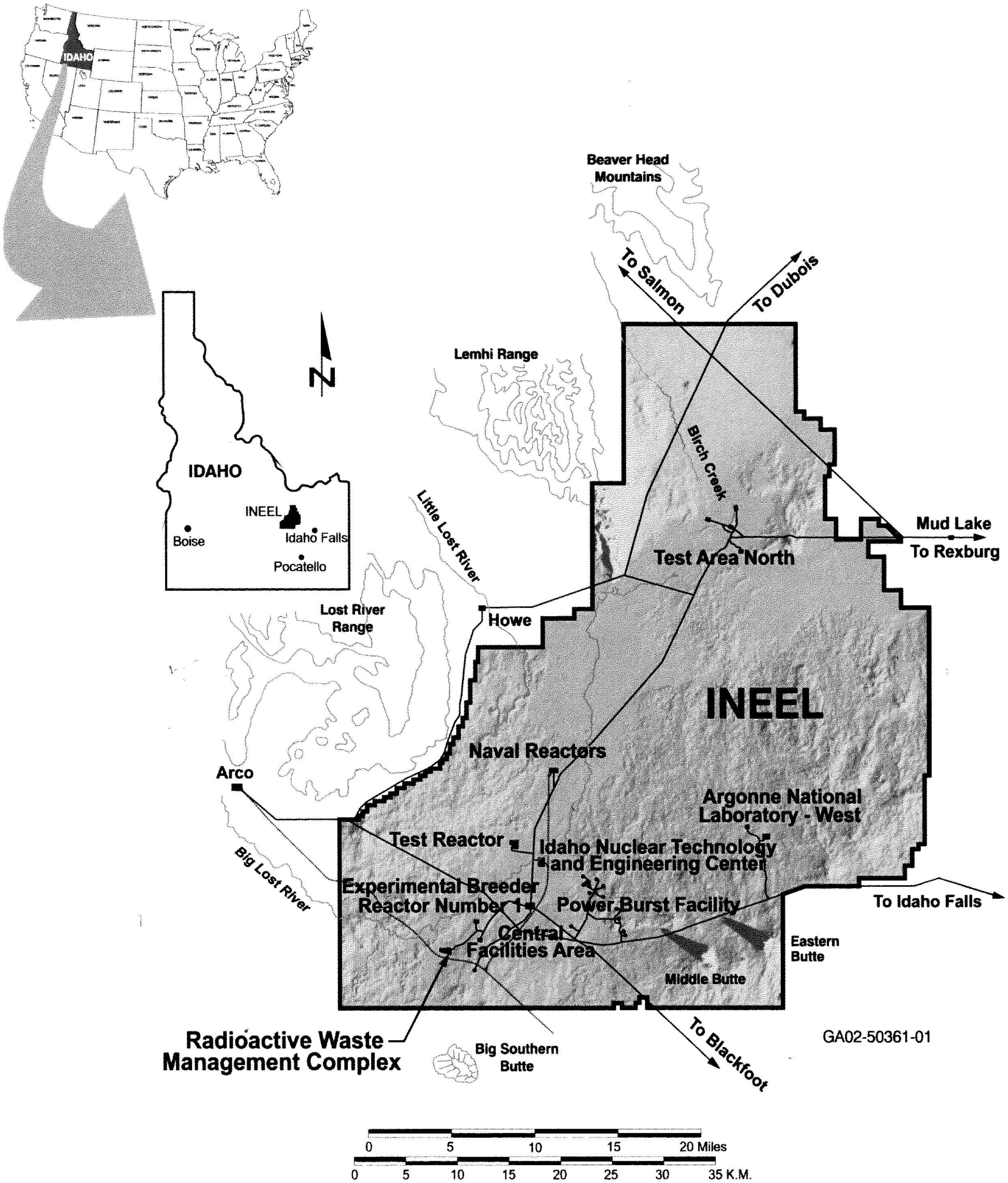


Figure 1. Location of the Radioactive Waste Management Complex and other major facilities at the Idaho National Engineering and Environmental Laboratory.

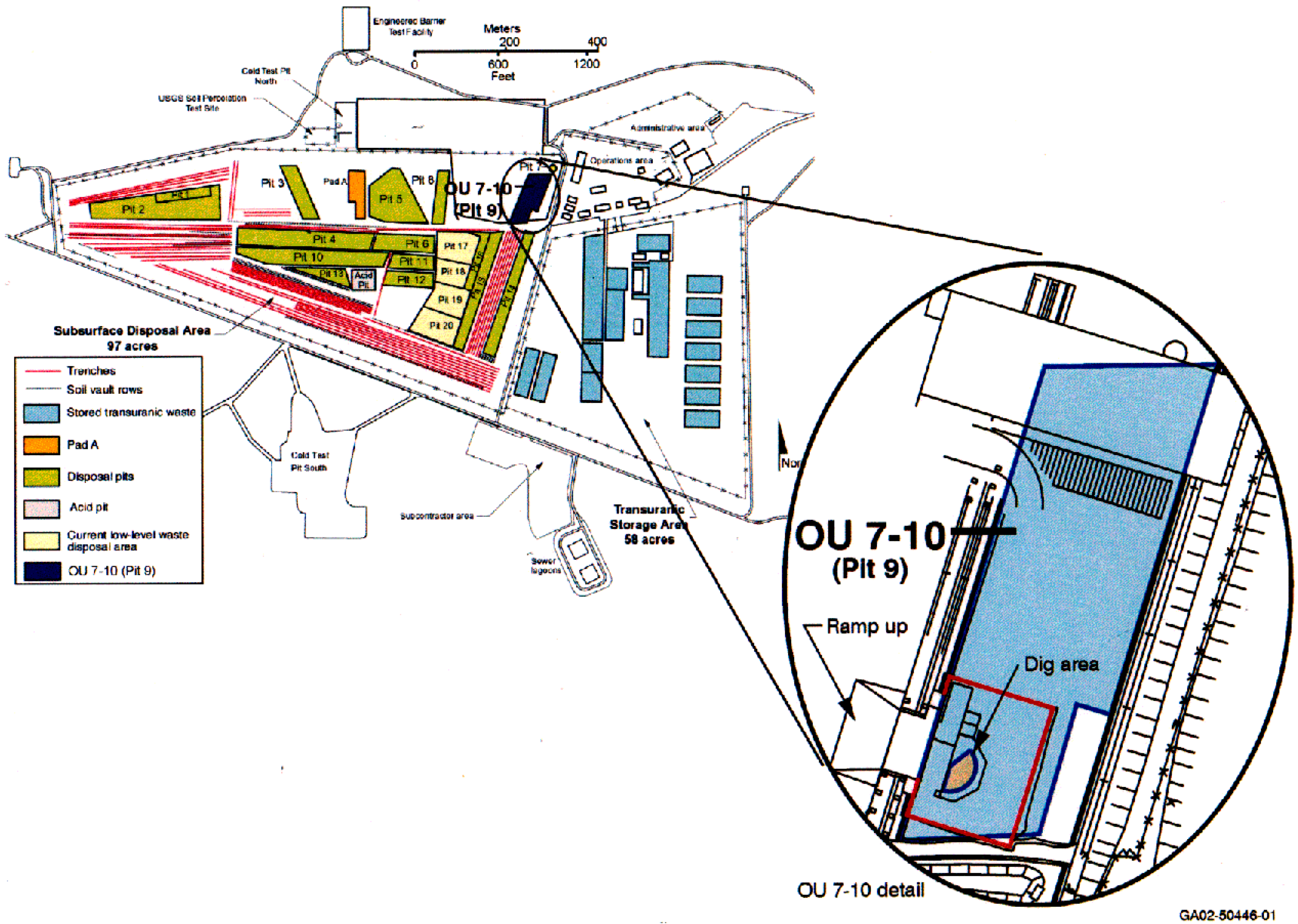


Figure 2. Map of the Subsurface Disposal Area showing Operable Unit 7-10 and the Glovebox Excavator Method Project.

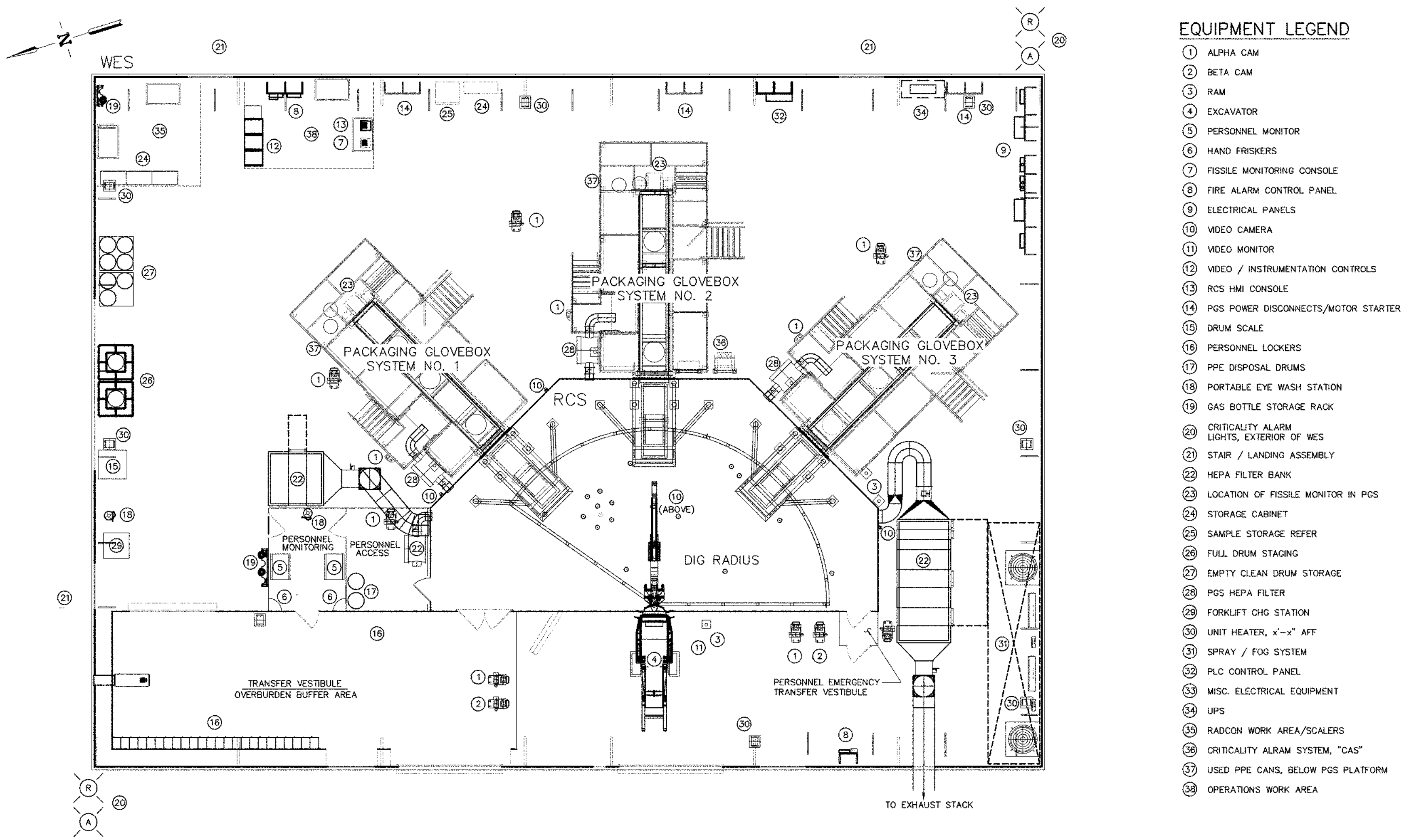


Figure 3. Glovebox Excavator Method layout.

## 1.2 Purpose of Document

The purpose of this document is two-fold. First, this document provides information regarding the location and type of waste materials expected within the excavation area and their general distribution across that area. In addition, this document provides methodology for excavating the waste, relocating obstructive probes, and core sampling of the underburden. Justifications for removing specific probes while leaving others within the excavation area are included in later sections. A discussion of drum segmentation (i.e., breakup) is also provided. Second, this document is intended to provide project personnel with narrative text and logic flow diagrams for planning the operational tasks that need to be performed as part of the project. The process logic diagrams (see Appendix C) represent the flow sequence, decision points, and decision paths of the operational tasks to be performed. Steps identified in this document are not intended to bind operations to these specific steps; rather, they provide an overview of the project process logic, which was used to develop the design. These narratives will be used to prepare operational procedures; however, as operational procedures are developed, the procedures will supercede the narrative. There is no intent to keep the narrative up to date as operational planning evolves. Operational tasks will excavate, retrieve, sample, package, handle, and store the interstitial soil and waste zone materials onsite pending a decision on the final disposition. Once the project has completed retrieval operations and sampled the underburden, the systems and facilities will be placed in a safe shutdown state.

In this document, operations activities are broken down into the following processes: (1) overburden removal and packaging, (2) waste zone material retrieval and packaging, (3) drum change-out, (4) waste transportation and storage, (5) sample handling and transportation, (6) underburden sampling, and (7) shutdown. Additional processes for handling special case waste, safety basis outliers, and the applicable storage facility's waste acceptance criteria (WAC) prohibited items may be required during operations. For this document, general process steps will be identified for various waste types. Specific procedures will be developed for each general process.

The sequential process steps shown in the process logic diagrams in Appendix C and described in the following narratives are the basis for the process model found in the *OU 7-10 Glovebox Excavator Method Process Model* (Anderson 2002). This model simulates project operation, including proper activity sequencing, activity time estimates, and other process limitations and subtasks; the model also provides the project with a tool for trade studies, design decisions, and operations planning.

This document also includes the project process flow diagrams in Appendix D. These diagrams document estimated rates for and total quantities of materials processed during project operations (e.g., overburden soil sacks generated per 12-hour shift and total waste drums generated). In addition, design firewater and dust suppression flow rates are provided. Process stream quantities used in these flow diagrams are based on the project process model mentioned above.

# 2. WASTE ZONES

As shown in Appendix A, within the excavation zone eight separate waste types are anticipated to be present. These eight waste types were generated within five separate Rocky Flats Plant buildings listed in Table 1. The eight waste types of concern are:

- Graphite: Building 776
- Empty Drums: Building 746
- Combustibles: Buildings 123, 559, 771, 742, 744, 776, and 779
- Noncombustibles: Buildings 742, 746, 771, and 776
- 741, 742, 743, and 745 Sludge: Building 774.

Table 1. Waste generators.

| GENERATOR | | |
|---|---|---|
| **Building numbers** | **Primary Functions** | **Major Wastes Generated** |
| 771 | Pu Chemical Recycle and Am-241 recovery | Graphite, Ion-exchange Resins, Glass, Filter Pads, Wet and Dry Combustibles |
| 776 | Foundry, Machining, Rolling and Forming | Plutonium, Beryllium, High Enriched Uranium (HEU), Depleted Uranium (D-38) |
| 123 | Health Physics and Medical Facilities | Bioassay and Medical Wastes (radioactively contaminated) |
| 746 | Empty Drums | Empty Drums |

| Sludges from building 774 | Primary Functions | Major Wastes Generated |
|---|---|---|
| 741 sludge | First Stage Water Treatment | Pu, Am, Hydrated Oxides of Fe, Mg, Si: sludge 50-70% water |
| 742 sludge | Second Stage Water Treatment | Pu, Am, Hydrated Oxides of Fe, Mg, Si: 50-70% water (lower activity than first stage) |
| 743 sludge | Organic Sludges | CCl4, Regal Oil, 111TCA, TCE, PCE, Oil Dry |
| 745sludge | Evaporator Salts – Nitrate Sludges | NaNO3, KNO3, paper, rags, gloves, etc. |

In comparing the excavation site's historical waste shipment data with probe data taken at the excavation site, three general waste zones (as shown in Figure 4) were derived. These waste zones are:

1. **Graphite and 741 Zone:** Located in the northeast corner of the excavation site, the data indicate that this zone may contain all of the graphite and 741 sludge within the excavation area. The zone is estimated to comprise 12% graphite, 17% 741 sludge, 21% combustibles, 32% noncombustibles, and 18% empty drums. Percentages are given as drum number percentages.

2. **743 Zone:** Located just east of the excavation site center, the data indicate that this zone may contain all of the 743 sludge and possibly all of the 745 and 742 sludge within the excavation area. The zone is estimated to comprise 53% 743 sludge, 4% 745 sludge, 6% 742 sludge, 11% combustibles, 4% noncombustibles, and 22% empty drums. Percentages are given as drum number percentages.

3. **Combustible and Noncombustible Zone:** The data indicate that this zone may encompass the entire excavation site and is estimated to comprise 31% combustibles, 10% noncombustibles, and 59% empty drums. Percentages are given as drum number percentages.

The purpose behind identifying waste type locations within the excavation site is three-fold. First, during generation of the excavation plan, it is desirable to know if the excavation site consisted of a uniform waste distribution or if specific waste zones were present. As shown on Figure 4, the site is anticipated to consist of three general waste zones ranging from mildly contaminated waste (consisting primarily of combustibles) on the right side of the pit to the moderately contaminated sludge waste in the middle and highly contaminated graphite waste on the left side of the pit. Based on these findings in combination with probe removal logistics and Retrieval Confinement Structure (RCS) ventilation parameters, the waste excavation plan is based on a staged excavation and core sampling campaign that begins at the mildly contaminated right side of the pit and ends on the left, more contaminated side.

Second, predicting the waste type(s) being sent to the packaging gloveboxes during excavation operations is advantageous. Pre-acquired knowledge of the waste types entering the gloveboxes enables the glovebox operators to anticipate the different types of waste.

Finally, Section 3 of this report provides the excavation plan for removing the overburden, excavating the waste, and core sampling the underburden. The excavation plan entails excavating waste and exposing underburden for core sampling in proximity to the P9-20 probe. Knowing the location and concentration of the various plutonium plumes—which are primarily centered around the P9-20 probe cluster—allows excavation of the less-contaminated material within this area first, thus reducing the risk of cross contamination.

## 2.1 Graphite and 741 Sludge

### 2.1.1 Graphite Shipment Data vs. Probing Data

Historical waste shipment data (provided in Appendix A) were reviewed to determine the quantity, type, and location of waste within the Glovebox Excavator Method Project excavation area. Analysis of the shipment data indicates that the types and quantities of waste delivered were consistent with subsurface data; however, the disposal record location is not consistent with the probing data for some waste types. The following provides a discussion of the analysis and results.

Figure 5 (left) provides the historical shipment data for all shipments containing graphite around the excavation site (dark blue pie shape). The shipment locations that did not contain graphite are shown as dark blue rectangles and the shipment locations that did contain graphite are shown as red/pink rectangles. The red numbers on the red/pink rectangle indicate the number of 55-gal drums of graphite within that shipment.

Figure 5 (middle and right) provides the plutonium 239 (Pu-239) probe data for the excavation site and surrounding areas. Because of the graphite's relatively high plutonium content, these probe data provide a good indication of graphite location within the excavation site. As indicated by the probing data shown in Figure 5, graphite can be found within the northeast corner of the excavation site at elevated concentrations of 1,000 nCi/g, while the lower graphite concentration of 100 nCi/g (near the probe detection limit) expands to the south.

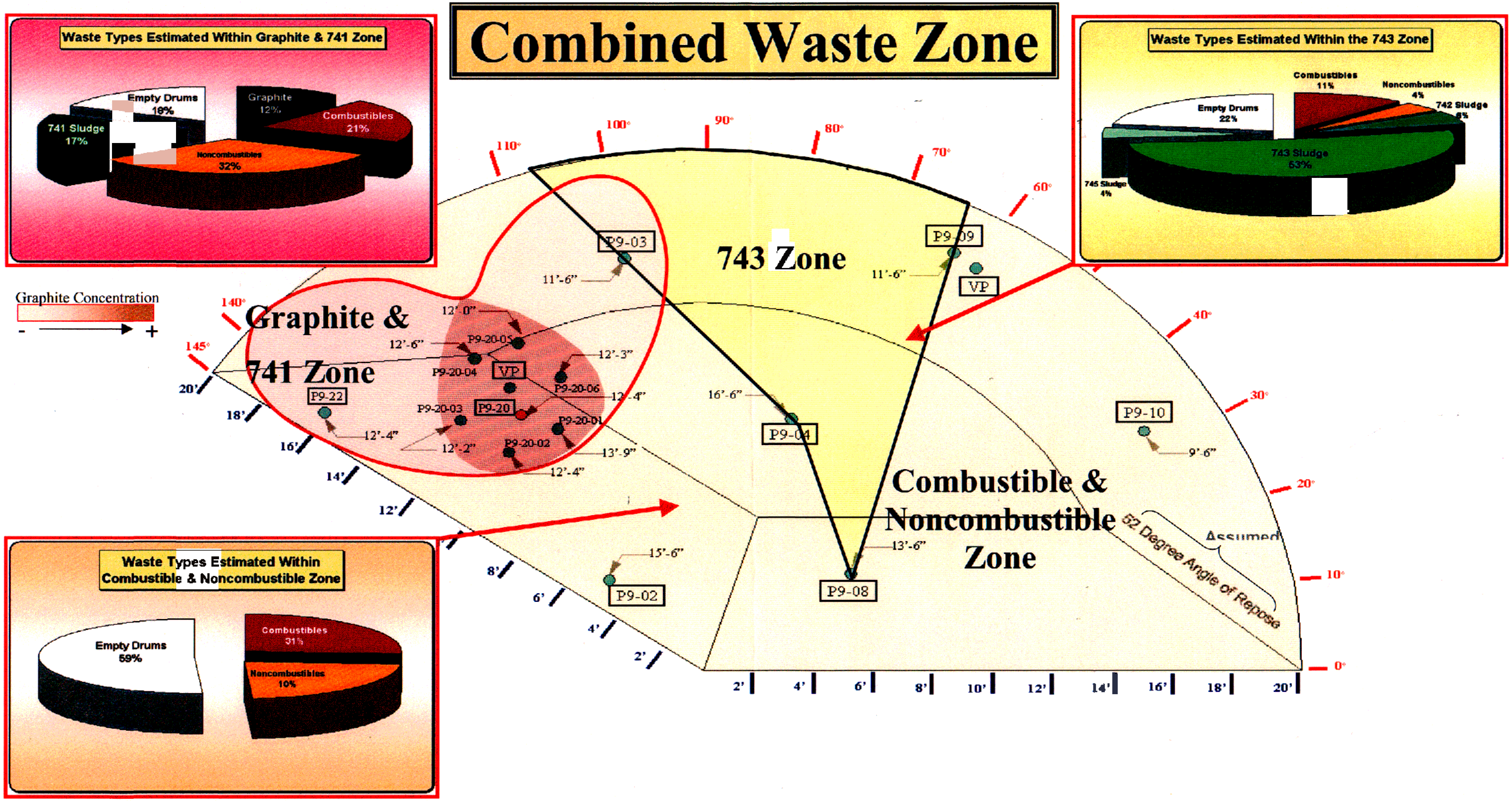


Figure 4. Combined waste zone.

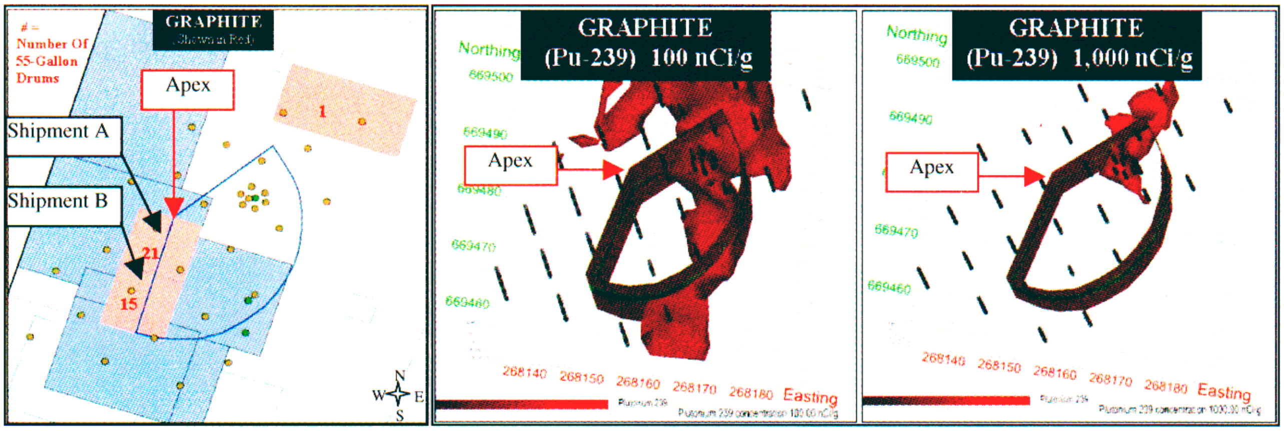


Figure 5. Graphite shipment data and probe data.

A disconnect is found when comparing the graphite shipment data to the probing data in Figure 5. Shipment records indicate a large shipment of graphite (Shipments A and B in Figure 5) just south of the excavation site apex. The probing data indicate this waste is actually located in the northeast corner of the excavation site.

As indicated in Figure 6 (left), the P9-20 probe (probe that has indicated the highest concentration of Pu-239) could have penetrated the single "hot" drum from Shipment C and caused the elevated Pu-239 concentration. Figure 6 (right) is a three-dimensional rendition of a 20 × 20-ft area that encompasses the P9-20 probe. Within Figure 6 (right), several distinct yellow/red Pu-239 plumes are located near the P9-20 probe location. The multiple plutonium plumes indicate multiple drums containing plutonium at various depths. The concluding assumption, based on the probing data, is:

***Assumption #1: Shipments A and B are located within the northeast corner of the excavation site.***

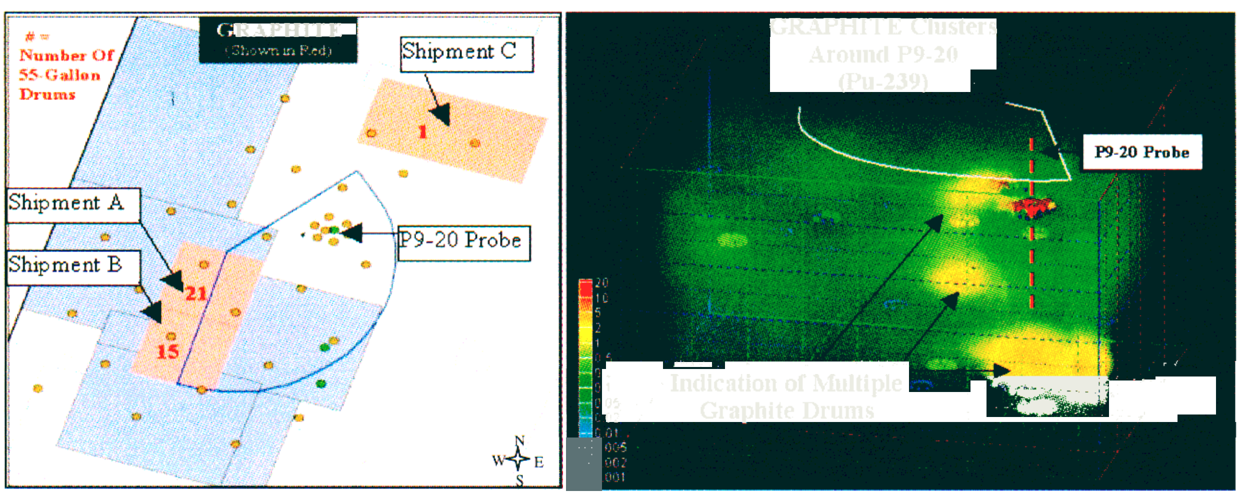


Figure 6. Graphite probe data (multiple drum).

**NOTE:** The indication of multiple drums within the P9-20 probe area does not exclude Shipment C as a possible waste source within and around the P9-20 probe cluster.

### 2.1.2 741 Sludge Shipment Data vs. Probing Data

Figure 7 (left) provides the historical shipment data for all shipments around the excavation site containing Series 741 sludge. The red numbers on the red/pink rectangles indicate the number of 55-gal drums of Series 741 sludge within that shipment.

Figure 7 (right) provides the americium probe data for the excavation site and surrounding areas. Because of the 741 sludge's high americium and protactinium (Pa—daughter product of Am) content, these probe data provide a good indication of the 741 sludge location within the excavation site. As indicated by the probing data, Series 741 sludge can be found within the northeast corner of the excavation site at elevated concentrations.

The same discrepancy found when comparing the 741 sludge shipment data to the probing data in Figure 7 is found when comparing the graphite shipment data to the graphite probing data in Figure 5. The probing data further support the conclusion of Assumption #1 that Shipment A is located within the northeast corner of the excavation site.

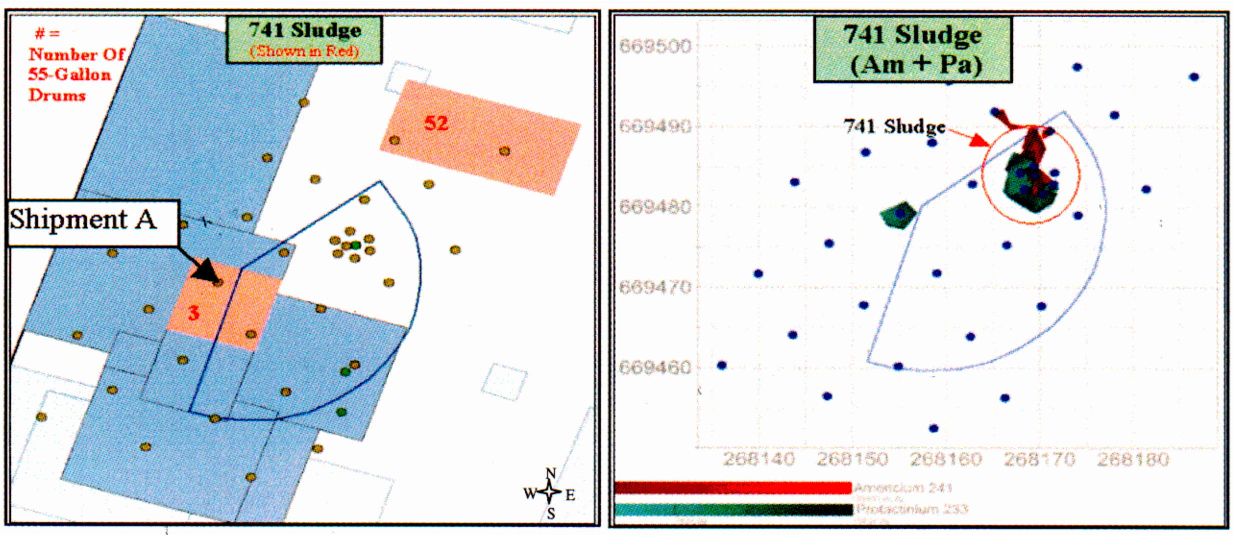


Figure 7. 741 Sludge shipment data and probe data.

## 2.2 743, 742, and 745 Sludge

### 2.2.1 743 Sludge Shipment Data vs. Probing Data

The Series 743 sludge is primarily composed of carbon tetrachloride ($CCl_4$). For this reason, the presence of Series 743 sludge can be indicated through the presence of chlorine within the excavation site area, which has been investigated in the probing program.

Figure 8 (left) provides the historical shipment data for all shipments around the excavation site containing Series 743 sludge. The red numbers on the red/pink rectangles indicate the number of 55-gal drums of Series 743 sludge within that shipment. Figure 8 (right) provides the chlorine probe data for the excavation site and surrounding areas. As indicated by the probing data, Series 743 sludge is primarily found east of the excavation site center. Since shipment and probing data would appear to be consistent, the concluding assumption, based on the probing data, is:

*Assumption #2: The 743 sludge is bordered by P9-03, -04, -08, and -09 probes (east side of excavation site).*

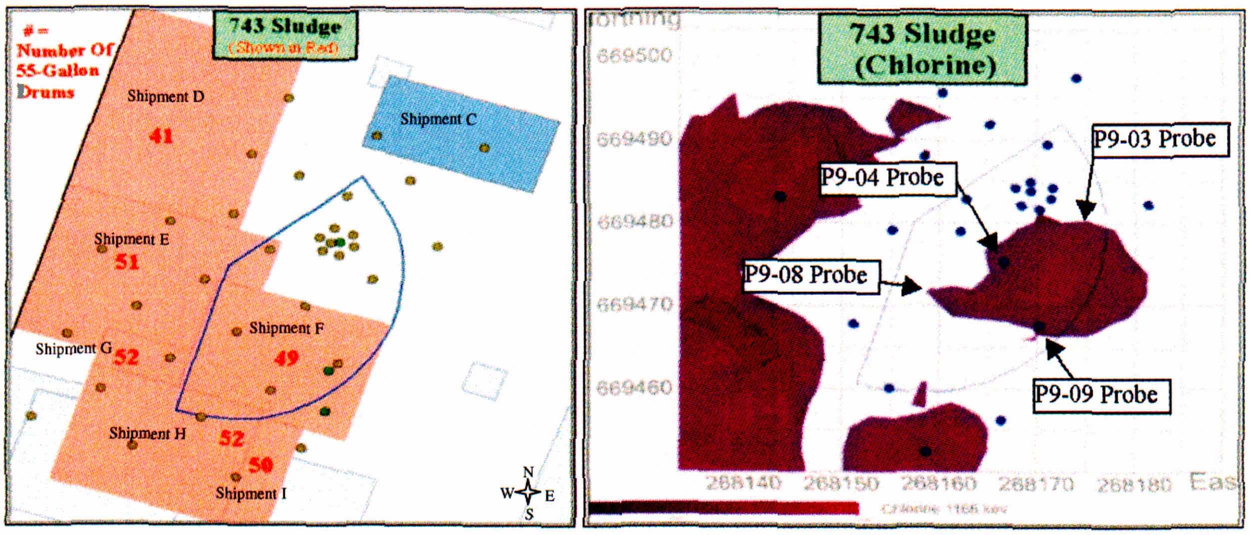


Figure 8. 743 Sludge shipment data and probe data.

### 2.2.2 742 and 745 Sludge Shipment Data

Figure 9 provides the historical shipment data for all shipments around the excavation site containing Series 742 sludge (left) and Series 745 sludge (right). The shipment locations that did not contain the corresponding sludge are shown as dark blue rectangles and the shipment locations that did contain the corresponding sludge are shown as red/pink rectangles. The red numbers on the red/pink rectangle indicate the number of 55-gal drums of Series 742 sludge (left) or Series 745 sludge (right) within that shipment.

Because of the similarities between shipment distribution of Series 742 sludge, Series 745 sludge, and Series 743 sludge (see Figure 8), the concluding assumption, based on the assumption that Series 743 sludge is bordered by P9-03, -04, -08, and -09, is:

*Assumption #3: The 742 and 745 sludge are bordered by P9-03, -04, -08, and -09 probes (east of the excavation site center).*

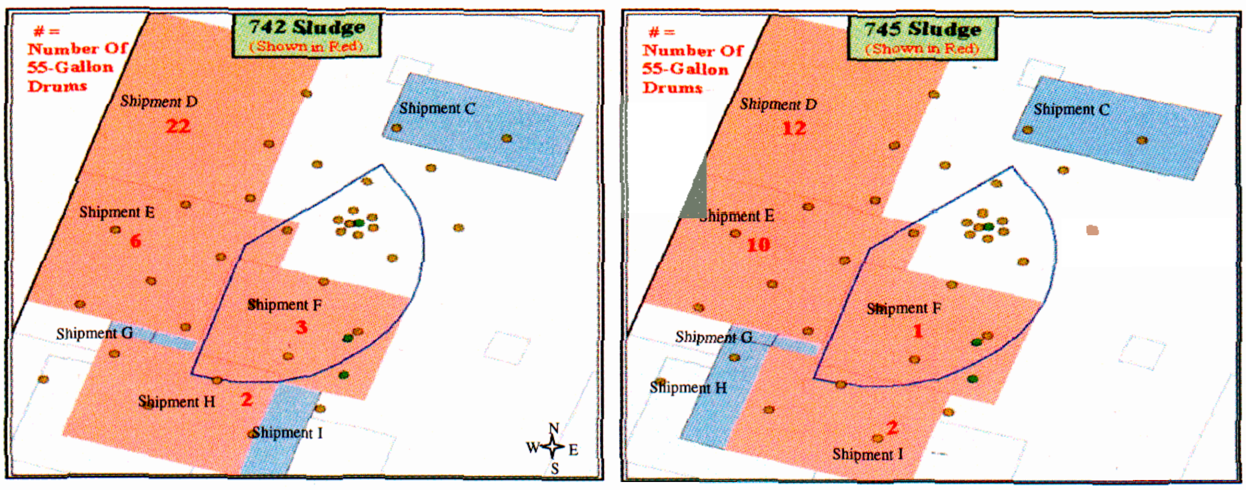


Figure 9. 742 and 745 Sludge shipment data.

## 2.3 Combustibles, Noncombustibles, and Empty Drums

Two separate waste zones (Graphite/741 Zone and 743 Zone shown in Figure 4) are formed within the excavation site based on the previous assumptions concerning graphite, Series 741 sludge, and Series 743 sludge. Based on historical waste shipment data (provided in Appendix A), the only other wastes deposited around the excavation site are combustibles, noncombustibles, and empty drums.

Figure 10 provides the historical data for all shipments containing combustibles (left), noncombustibles (center), and empty drums (right) around the excavation site. The shipment locations that did not contain the corresponding waste form are shown as dark blue rectangles and the shipment locations that did contain the corresponding waste form are shown as red/pink rectangles. The red numbers on the red/pink rectangle indicate the number of 55-gal drums of the corresponding waste form within that shipment.

As shown in Figure 10, the combustibles, noncombustibles, and empty drums are relatively evenly distributed throughout the shipment locations with a higher number of combustible and noncombustible waste drums found in Shipments A and B. As a result of Assumption #1 that states Shipments A and B are located within the northeast corner of the excavation site, the concluding assumption for combustibles and noncombustibles is:

***Assumption #4: Combustibles, noncombustibles, and empty drums are evenly distributed throughout the excavation site with the exception that a higher concentration of combustibles and noncombustibles are located within the northeast corner of the excavation site.***

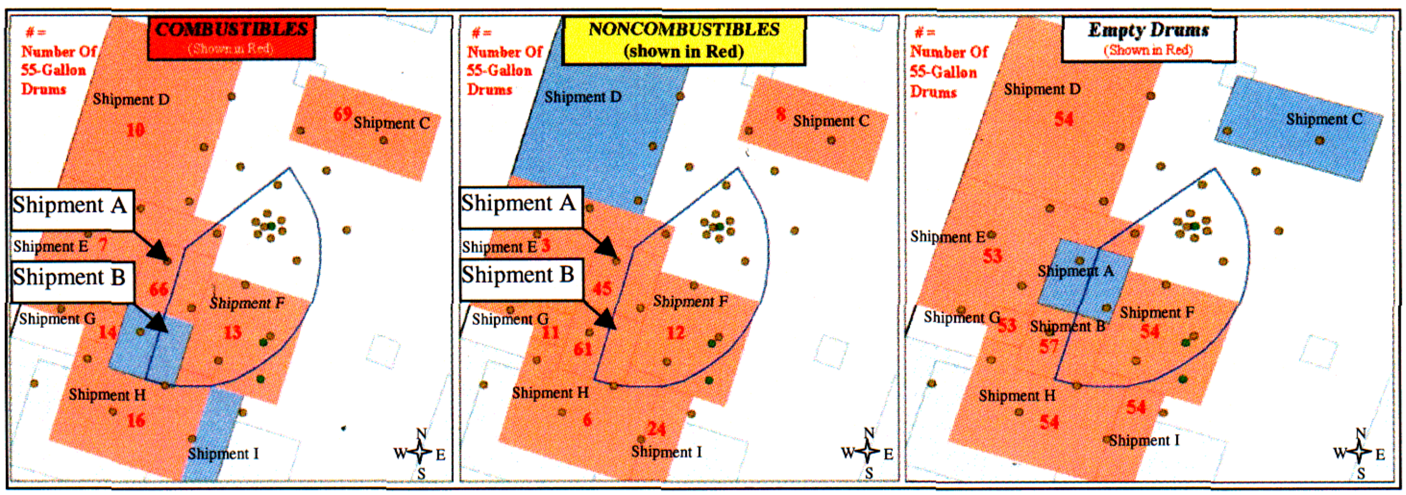


Figure 10. Shipment data for combustibles, noncombustibles, and empty drums.